Wireless and Mobile Computing

An Overview and Quick Reference for State Agency IRMs and Executives

DEPARTMENT OF INFORMATION RESOURCES
P.O. Box 13564 • Austin, TX 78711-3564 • www.dir.state.tx.us/
Tel: (512) 475-4700 • Fax: (512) 475-4759

Acknowledgements

Thanks to Synchrologic for permission to use their glossary as a basis for the glossary in this document.

Department of Information Resources
P.O. Box 13564, Austin, TX 78711-3564
Tel: (512) 475-4700
Fax: (512) 475-4759
www.dir.state.tx.us

Table of Contents

Executive Summary

This paper gives an overview of the current state of wireless and mobile computing, additional sources of information, and high-level guidance about how and when to use these new technologies. First, however, a clear distinction must be made between the terms "wireless" and "mobile."

Wireless refers to the method of transferring information between a computing device, such as a personal data assistant (PDA), and a data source, such as an agency database server, without a physical connection. Not all wireless communications technologies are mobile. For example, lasers are used in wireless data transfer between buildings, but cannot be used in mobile communications at this time.

Mobile simply describes a computing device that is not restricted to a desktop. A mobile device may be a PDA, a "smart" cell phone or Web phone, a laptop computer, or any one of numerous other devices that allow the user to complete computing tasks without being tethered, or connected, to a network. Mobile computing does not necessarily require wireless communication. In fact, it may not require communication between devices at all.

There are some inherent challenges in using these technologies on a widespread basis. Table 1: Wireless Connectivity Technologies outlines some of them. One particularly troublesome issue for wireless communications is security. For instance, some wireless technologies are not suitable for applications in which sensitive client information is exchanged between a central database and a remote device because the data signal can be intercepted. Furthermore, ensuring adequate security for such a situation could add significant expense to a wireless application.

In addition, both wireless and mobile devices incur support costs that exceed those of typical desktop equipment. Because of this, industry experts recommend that an organization standardize its wireless and mobile application environment in order to reduce the burden on IT staff.

When deciding on whether to implement a wireless and/or mobile application, two key factors must be considered:

- **Usage.** How will the device or application be used? Is the application used for simple messaging, or does it reengineer complex and sensitive processes? Usage and content determine the necessary complexity of the device, the level of security and reliability needed, and whether or not the application needs continuous, immediate access to data.
- **Amount of data.** How much data must be exchanged between the device and the central data repository? Is the data cumbersome, with

intense bandwidth requirements? This factor determines which connectivity technologies would be the most fitting to use.

Figure 1: Selection of Connectivity illustrates the relationship between these two factors. In general, the more complex the application, the more likely it will require a complex device such as a laptop computer. Furthermore, the more data the application must exchange with a central database, the more expensive a wireless solution will be.

Technology Overview

This report provides a cursory look at wireless and mobile technologies, summarizes their current state of development, and shows how to apply these technologies to business needs. It covers wireless and conventional landline (also called "wireline") communications, as well as a wide variety of computing devices.

Definitions

Wireless and Mobile

Wireless communication is simply data communication without the use of landlines. This may involve cellular telephone, two-way radio, fixed wireless (broadband wireless, described below), laser (free space optics, described below), or satellite communications.

Mobile, or "untethered," computing means that the computing device is not continuously connected to the base or central network. Mobile devices include PDAs, laptop computers, and many of today's cell phones (aptly called "smart phones"). These products may communicate with a base location with or without a wireless connection. An example of a wireless mobile application is using a modem-equipped PDA to receive text messages via satellite technology. A non-wireless mobile example could involve sending data from a laptop to a central database or network server over a temporary dial-up connection. In the latter example, the laptop can still be used as a mobile device regardless of whether or not it ever connects to another computing device.

Additional Terms

Wireless and mobile computing are dynamic and evolving industries that often overlap. A glossary is included in this document, but it is not a comprehensive list of wireless and mobile industry terms. Instead, it is intended to provide a quick reference for acronyms and jargon most likely to be of use to state agency Information Resource Managers (IRMs) and executives. The glossary also supplies links to more detailed information that is available online.

Wireless Technologies

The use of wireless technology in the day-to-day transfer of information is increasing rapidly, and new developments are continually expanding its role in modern communication. Even so, the majority of wireless technologies do not yet provide as much bandwidth or accessibility as landlines. This is especially true for cell phones and two-way radio. Furthermore, the transmission range for wireless technologies usually is inversely related to the data transmission speed. That is, the further the wireless signal has to travel, the less data it can carry per second.

The gap between landline and wireless technologies is narrowing, though. The most advanced developments of wireless broadband deliver downstream data transfer speeds of up to 1.5 Gbps (gigabits per second) and upstream speeds around 200 Mbps (megabits per second). These data transfer rates are comparable to today's fiber optic speeds. At this time, however, wireless broadband initiatives typically require fixed, rather than mobile, receivers.

Another technology, Free Space Optics, may be able to offer even higher data transmission rates than wireless broadband. This technology also requires fixed-position receivers, however, and is only in the beginning stages of implementation in select markets.

Finally, satellite communications can offer very attractive transmission rates, but the cost per station (receiver) is usually quite high, typically $1,000 or more.

Mobile Devices

Giga Information Group suggests[1] a categorization of five different types of mobile devices:

1) Laptop computers
2) PDAs and handheld PCs
3) Pagers
4) Smart phones and cellular phones
5) Task devices, such as bar code scanners

Laptops are typically used and supported in the same way as desktop PCs. In fact, many organizations have replaced desktops with their portable cousins as the workforce has grown increasingly mobile.

PDAs, however, are the least planned-for and supported devices. They are undergoing rapid evolution and are being brought into organizations in the same way the earliest PCs were. That is, adventurous early adopters buy the devices for their personal use and then ask IT departments to integrate the devices into the corporate IT environment.

At present, PDAs are most often used for storing and synchronizing personal information such as addresses, schedules, and E-mail. However, the medical industry has developed numerous applications for PDAs. At least one Web ring (a collection of Web sites with a common topic) has been created to discuss medical software that automates functions such as patient and diagnostic data entry, patient monitoring and diagnosis, and messaging. In a hospital setting, these applications may include wireless communication between staff members' handheld devices and a base station at which patient information is stored.

Smart phones that allow users to access phone calls, two-way radio transmissions, and paging and data transmissions on one device are also finding applications in hospitals and other situations that have intense and constant need for time-sensitive communications. Pagers that

support one- and two-way text messaging are also used in similar situations. Support for these devices is most often provided by third party vendors.

Task devices such as the parcel tracking devices used by Federal Express (FedEx) and the United Parcel Service (UPS) delivery personnel are most often bought as part of a complete system from a third-party vendor. Because they are frequently mission-critical, most corporations support task devices as rigorously as desktop computers.

Table 1 provides a quick reference to wireless connectivity for mobile computing devices.

Table 1: Wireless Connectivity Technologies

Technology	Costs	Advantages	Disadvantages
On-premises wireless messaging (e.g., by using messaging pagers, PDAs)	■ Low fixed cost for simple, shrink-wrapped applications and devices ■ Low operating cost	■ Shrink-wrapped applications do not require IT support ■ Easy, fast implementation for shrink-wrapped applications	■ Small data display area ■ Range limited to few hundred feet ■ Custom applications may require additional support ■ Signals can be intercepted, posing security risk
Wireless Local Area Network (WLAN)	■ Low to high capital cost, depending on complexity of network and data rate ■ Low to moderate operating cost depending on stability of software	■ Medium to high data rates ■ User interface similar to landline Local Area Network (LAN); little additional end-user training is needed ■ Eliminates need for wiring in older buildings or where impractical. ■ Can be combined with landline LAN to network mobile devices on a large campus	■ New technology for most IT departments; another support burden ■ More expensive than landline LAN for equivalent data rates ■ Not supported by most handheld devices ■ Very short range ■ Signals can be intercepted, posing security risk unless appropriate security measures are used
2.5G, 3G wireless devices (e.g., 2.5 generation cell phones)	■ No fixed costs except for mobile devices (usually phones) ■ High operating costs (per-minute connection charges)	■ Cell network supported by the vendor, usually the Internet service provider (ISP) ■ Wide area coverage in metropolitan areas ■ Fast implementation	■ Not widely implemented in U.S. ■ Low data rate except for newest technology in test markets ■ Coverage usually does not include rural areas ■ Small data display area ■ Poor Wireless Access Protocol (WAP) security

Continued next page

Table 1: Wireless Connectivity Technologies – *Continued*

Technology	Costs	Advantages	Disadvantages
Broadband wireless	■ Moderate fixed costs for receivers ■ Operating costs depend on ISP service level	■ Network supported by vendor (ISP) ■ High data rate may compete with T1 speeds ■ Potential low cost alternative to T1 in metropolitan markets	■ Currently available in only a few markets ■ Requires fixed point receiver for speeds greater than 384 Kbps ■ Coverage does not include rural areas ■ Security concerns are identical to those of Internet
Satellite	■ Low to high fixed costs for receivers, depending on the application ■ Low operating cost per data rate	■ Network supported by the vendor (ISP) ■ At present, easier and faster to get than DSL in many markets, especially rural ones ■ Medium to high download data rate; can be much better than T3 in dedicated applications	■ Upload data rate equivalent to dial-up ■ Off-the-shelf commercial offerings more expensive than cable or DSL with slower data rates ■ High speed, high capacity applications require custom engineering; difficult and expensive to implement ■ Signal can be intercepted, potentially compromising security
Free Space Optics	■ Low to high fixed costs for receivers, depending on the application ■ Low operating cost per data rate	■ Medium to high data rate; can be much better than T3 ■ Prices will be competitive with broadband wireless ■ Signal may be received at much greater distance than broadband wireless	■ In prototype stage ■ Coverage is unlikely to include rural areas in the near future ■ Reliability can be degraded by several environmental conditions, reducing data rate as distance increases ■ Requires fixed point receiver; appropriate only for data replication and synchronization ■ Signal cannot be intercepted without detection, providing security no other media can match

Mobile Users

Giga identifies[2] three types of mobile users:

1) Telecommuters who work away from the office but connect directly to the office from a remote location.

2) Casual telecommuters and other workers who work a few days per month outside the office.
3) Predominantly mobile employees

While both sets of telecommuters may reap similar benefits using mobile technologies, the wireless communications features of newer PDAs make handheld devices ideal for predominantly mobile professionals: Wireless and mobile E-mail and messaging applications address their needs for constant and immediate communication. However, this group, predominately executives, sales and service personnel, often work with a variety of ever-evolving applications with little, if any, technical training. The result is that they require more support than tethered users who work in environments with standardized hardware and connections. These mobile users also benefit from strong IT standardization policies and continual training.

There is little question that mobile computing can be a powerful tool with which to reengineer business processes. Primary benefits of such reengineering include reduced paper handling, reduced travel, improved data accuracy and timeliness, and reduced need for large central office facilities.

On the other hand, wireless communication is often prohibitively expensive or simply not feasible. For instance, sales and marketing support often require such large amounts of data that it is impossible to download it through current wireless communications. In such cases, mobile computing must rely on replication and synchronization of data over landlines.

Because of these drawbacks, it is important to balance the initial and ongoing costs of implementing these technologies, including training and support, against the potential benefits of time and monetary savings. Only then can a reasonable case for adopting extensive mobile and wireless methods of communication be presented.

Costs and Business Issues

Building a Business Case

Extracting the greatest benefit from any new business decision first requires cost analysis, projections on the potential return on investment (ROI), and finally, quantifiable results. Giga notes that applications that produce measurable improvements in accuracy, timeliness, or productivity are the most likely to be justifiable business investments[3].

Those measurable improvements are not limited to simply speeding up established procedures. Giga also states that "Some projects ... can deliver far greater impact by allowing the company to revise business processes...." However, they caution that savings and efficiencies are achieved only by planning and adoption of mobile computing as a strategic direction, not by passive acceptance of the technology.

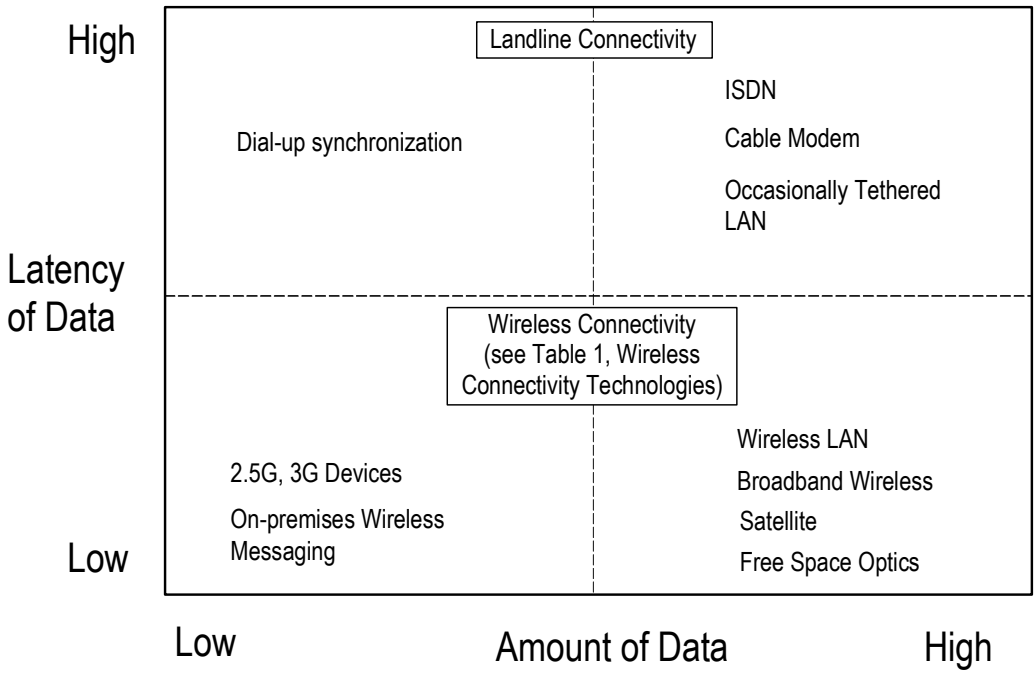
The immaturity of the market and the rapid evolution of both wireless and handheld devices make it difficult to build a business case for incorporating mobile and wireless functionality. Because of constant change, support costs for mobile users can be up to four times more than support costs for tethered users. That is because IT departments have standardized desktops as a way to reduce support costs, a tactic industry analysts recommend for mobile applications. Analysts also recommend that pilot projects in mobile computing build on existing back office databases and applications. This approach allows the application to be developed and evaluated quickly.

Connectivity Strategy

Since wireless data communication technology is usually more expensive than landline technology for equivalent data volume, it must be justified by a large or quick payback. For instance, the immediacy provided by some wireless connectivity options could preserve the value of information that would only degrade as time passes. Another possibility is that wireless computing would allow a company to offer an increased level of service, resulting in additional revenue. The value, timeliness, and type of information being used in a mobile task must be taken into consideration before implementing any kind of mobile or wireless strategy. Figure 1 illustrates how these decision factors come into play when selecting a mode of connectivity.

The horizontal axis represents the amount of data that the client must have to perform a task. For some activities, a simple message may suffice, requiring little wireless bandwidth and device memory. Currently, 2.5G and 3G phones, for example, could be used in this capacity. For other activities, a high-resolution bitmapped image may be necessary, which increases both bandwidth and memory requirements. In such cases, a more complex device, such as a laptop, could be used to transfer

Figure 1 - Selection of Connectivity



data over a traditional network in order to meet these requirements more effectively.

The vertical axis represents the data latency, or delay, that the task can accept. For some tasks, such as attending to medical emergencies, data must be delivered immediately. In this case, wireless mobility offers the chance to transfer information from remote locations without needing to access a landline. For others, such as analyzing seismic data, it may be acceptable to have some delay between the time the data is requested and the time it is received. In this case, the using wireless communication is not as crucial, and its level of benefit is diminished.

When determining connectivity options, the basic principle is to use wireless media where immediate message delivery is the main requirement, and use landlines for everything else. This is why a hospital may be able to justify a wireless local area network (WLAN) and PDAs for all employees, while social service and regulatory agencies may find that field service personnel can be more productive with laptop computers that are synchronized daily with a central office over a dial-up connection.

Security

Security for mobile, wireless computing is a particularly difficult problem. Some technologies, such as Free Space Optics, have more security because of the physical characteristics of the media. However, other technologies, such as cell phones and digital pagers, have almost no

security because of poorly designed communications protocols. More detail about this potentially serious shortcoming can be found in the white paper by Cisco Systems[4] described in the Annotated Bibliography at the end of this report.

There are options for bolstering security. For instance, industry analysts recommend firewalls for mobile devices wherever practical and antivirus software developers have added extensions into their products to support the most common handheld devices. Even then, there are no fool-proof solutions.

According to Giga[5], the situation is made more complex because mobile workers tend to be less technically adept than tethered workers are. Therefore, security for their devices must be automatic and transparent in order to be effective.

Support

Most organizations offer very limited support for PDAs because the devices are not mission-critical. As PDAs take on more of the roles of the traditional PC, IT departments will be required to extend similar support to those users. The most commonly advocated strategy is to standardize the PDA/handheld PC environment within the supported organization.

In those cases where mobile devices are used for more extensive applications, additional back office support is required. This includes support for data replication and synchronization, bandwidth management, and asset and configuration management. These tasks may be handled by database software, or by special software that has been developed to support mobile clients. Either way, additional IT support personnel are required.

Stability of Technology and Vendors

Wireless and mobile technologies are undergoing rapid evolution. For example, when this report was first drafted, one vendor had an aggressive schedule for implementing fixed wireless service in major U.S. cities. By the time of the final report, the company had abandoned the initiative because of unexpected advances in the performance of mobile wireless handsets. The time span: six months.

At the same time, telecommunications providers, Internet service providers (ISPs), and related industries are going through a painful period of consolidation. Spectacular bankruptcies and buyouts have disrupted telecommunications for many customers.

Thus, for risk-averse organizations such as state agencies, it is usually best to plan and build applications on more common and stable platforms rather than on leading-edge technologies.

Examples of Current Applications

Commercial Applications

Medical applications are currently in place at several large medical facilities, and there is at least one Web ring dedicated solely to medical applications for handheld PCs and PDAs. One application is data entry: The devices and methods used increase accuracy and completeness of data. In addition, such devices can be used unobtrusively where laptops would be impractical. Wireless communications are particularly useful because medical personnel are constantly on the move.

"Smart badges" have been pioneered by Olivetti in Britain. These devices can locate personnel anywhere on an organization's campus. The badges periodically transmit an infrared signal that identifies the badge. The sensor that receives the signal identifies the badge's location. A simpler version of the smart badge has been designed for tagging equipment. Object location can be narrowed down to an area within one or two feet using low-powered radio fields.

Sales and marketing support is also a frequent application, but organizations often prefer laptop PCs to handhelds because of greater hard disk capacity and screen display. Wireless communications are usually limited to messaging and other exchanges of relatively small amounts of data. However, it is common practice to replicate selected portions of a database from a server to a laptop PC over landlines before "going mobile." For instance, a sales representative could download a client's contact and purchasing history, as well as updates to a product catalog. This would be done prior to calling on the client to make the sales call more effective.

Field service support is also a rapidly growing market for wireless and mobile computing. Handheld devices seem to be the preferred instrument because they do not require keyboards. In addition, wireless communications are easier to operate than dial-up, foregoing the process of plugging in cables and establishing a connection over landlines. As noted later in this report, this type of application occurs in state government as well, specifically within the Texas State Board of Barber Examiners. Widespread adoption of such applications is hindered by the lack of bandwidth that is currently characteristic of wireless technology.

Applications in the State of Texas

The University of Texas at El Paso (UTEP)

Wireless networking provides " …higher bandwidth, more control, no monthly charges, no expensive and time consuming installation, and no adverse impact on the university's commercial Internet connection…" according to Anna Hines, CIO of the University of Texas at El Paso[6] (UTEP). It also allows UTEP to connect with the Universidad Autonoma

de Ciudad Juarez (UACJ) in Juarez, Mexico. This provides UACJ access to Internet2, the high-speed network developed by a collaboration of universities, private companies and U.S. government. It also provides UACJ access to the Mexican research network that is similar to Internet2.

In addition to providing wireless LAN access to students and faculty, UTEP plans to expand its wireless capabilities to include the city of El Paso. This will enable UTEP to connect to local school districts and allow local teachers to connect to Internet2. It will also allow UTEP to conduct teacher training via videoconferencing.

Texas State Board of Barber Examiners (TSBBE)

The TSBBE has eight inspectors visiting 15 to 20 shops on a daily basis. Inspectors use handheld computers with both wireless and dial-up capabilities to retrieve data on shops undergoing evaluation, enter data for reports, verify schedules, and check for assignment changes. They are also able to send the results of site reviews back to the main office immediately.

At TSBBE, mobile technology has eliminated paper forms, handwriting errors and duplicate data entry problems. An agency accountant indicated that the savings in both time and money has been estimated at $28,000 a year[7].

Glossary of Wireless and Mobile Terms

This is not a comprehensive list of industry terms. It is intended to provide a quick reference for acronyms and jargon that are most likely to be of use to state agency IRMs. Many of the following terms also supply links to additional information that is available online.

1xRTT. A 2.5G network standard adopted by vendors in the US for initial deployments. A more comprehensive definition is at home.cnet.com/wireless/0-1923403-8-7093240-4.html, and an overview of the technology and market can be found at www.cdg.org/3gpavilion/detailed_info/leung_digevent.pdf.

2.5G. Wireless technology development has been divided into "generations", with the first generation (1G) being analog wireless. The 2.5G (also 2G+) designation identifies technologies in between today's second-generation (2G) digital technologies and the emerging, higher-speed third-generation (3G) technologies. An overview of current wireless technologies can be found at sic.nvgc.vt.edu/SICstuff-virtual/BURT/WWW/WIRELESS/intro.htm.

3G. An industry term used to describe the next generation of public wireless voice + data networks. To qualify as 3G, a network must meet certain requirements for speed, availability, reliability, and other criteria set forth by the International Telecommunications Union. There are many 3G network technologies being developed. Generally, they are packet-based, "always on" networks. See also *2.5G*.

This overview of mobile telephony history describes the differences between generations of wireless devices: www.alcatel.com/telecom/ssd/keytech/nss/guide.htm#thumb.

802.11. A family of wireless LAN specifications. The 802.11b standard is seeing widespread acceptance and use on corporate campuses and at commercial facilities such as airports and coffee shops that want to offer wireless networking to their patrons. A more detailed technical definition can be found at www.pcwebopedia.com/TERM/8/802_11.html.

Access point. A radio-based bridge that connects a wired LAN to a wireless network or device. Access points may be potential security vulnerabilities. See www.nwfusion.com/newsletters/wireless/2001/00960610.html for more information.

AMPS. An acronym for **A**dvanced **M**obile **P**hone **S**ervice. A term used for the first generation of analog wireless technology. Many AMPS networks are now being converted to TDMA or CDMA. See also *2.5G* and *3G*.

Bandwidth. The capacity of the network "pipe" or channel for communications in landline networks. In wireless networks, bandwidth is determined in part by the range of frequencies that can carry a signal, as well as efficiency of the wireless network for supporting multiple "conversations" on any given frequency. Bandwidth is measured in Kbps (**k**ilo**b**its **p**er **s**econd) or Mbps (**m**ega**b**its **p**er **s**econd). For a somewhat more technical definition, see searchnetworking.techtarget.com/sDefinition/0,,sid7_gci211634,00.html.

Bluetooth. A short-range wireless standard that specifies radio connections between devices within a 10-meter range of each other. Bluetooth is designed as a Personal Area Network (PAN, or WPAN for "Wireless Personal Area Network") technology with a wide variety of theoretical uses. More details can be found at searchnetworking.techtarget.com/sDefinition/0,,sid7_gci211680,00.html.

Bridge. A device that connects two local-area networks (LANs), or two segments of the same LAN. Bridges simply forward packets from one segment to another without analyzing or routing messages. This allows them to connect dissimilar networks (e.g., a bridge can connect an Ethernet and Token-Ring network). For a more detailed definition, see searchsecurity.techtarget.com/sDefinition/0,,sid14_gci211705,00.html.

Broadband. A generic term that implies higher data transmission rates than what is available through dial-up connections, which max out at 56 Kbps. The exact meaning of the term differs according to who is using it. "Broadband" may describe telecommunication in which a wide band of frequencies is available to transmit information. Or, it may simply mean data transmission rates in excess of 56 Kbps. For some, it means rates in excess of 144 Kbps, depending on the vendor that is describing it. For more detail on this fuzzy definition, see www.techweb.com/encyclopedia/defineterm?term=broadband. See also *Bandwidth*.

CDMA. Acronym for **C**ode **D**ivision **M**ultiple **A**ccess, a family of protocols used in 2G and 3G cellular networks that use spread spectrum techniques. U.S. carriers such as Sprint PCS and Verizon use CDMA technology in their wireless networks. More details can be found at searchnetworking.techtarget.com/sDefinition/0,,sid7_gci213842,00.html.

CDPD. Acronym for **C**ellular **D**igital **P**acket **D**ata, a specification for supporting wireless access to the Internet and other public packet-switched networks. The specification offers mobile users access to the Internet at up to 19.2 Kbps. CDPD also supports Internet Protocol (IP), IP multicast (one-to-many) service, and the ISO Connectionless Network Protocol (CLNP). For details, see

searchnetworking.techtarget.com/sDefinition/0,,sid7_gci213843,00.html.

Cellular. General name for analog and digital networks in which a user calls from a mobile telephone to a nearby transmitter. The transmitter's span of coverage is called a cell. As the caller travels from one cell or area of coverage to another, the telephone signal is passed on to the next transmitter.

Circuit Switched. A type of network in which a physical path (usually consisting of wires) is dedicated to a single connection between two devices. The traditional phone network is circuit switched; during a call, no other devices can use the circuit between the two that are connected.

Data Synchronization, Data Syncing. The process of sending data updates between a mobile computing device and a central database or applications server. This could entail, for example, synchronizing the calendar on a PDA with the calendar on a desktop computer so that both show appointment updates. The need for synchronization has spawned its own special interest group that has proposed a protocol, SyncML. Additional details and white papers on the topic can be found at www.syncml.org/.

Downstream. Transmission of data from an information source to an end user. For instance, Web pages are transmitted downstream from the Web site to the end user's browser.

Dual Band Mobile Phone. A mobile phone that picks up analog signals when a digital signal fades. The handset operates on both 800 MHz analog cellular and 1900 MHz digital PCS frequencies.

EDGE. Acronym for **E**nhanced **D**ata for **G**SM **E**volution. A faster technology for GSM and TDMA networks that may offer wireless data transfer of up to 384 Kbps. An overview of GSM that includes EDGE can be found at ccnga.uwaterloo.ca/~jscouria/GSM/gsmreport.html.

ETSI. Acronym for the **E**uropean **T**elecommunications **S**tandards **I**nstitute, an organization that establishes telecommunications standards for Europe. ETSI guidelines usually follow standards produced by international standards groups. Their Web site is at www.etsi.org/, and a brief explanation of their functions can be found at searchnetworking.techtarget.com/sDefinition/0,,sid7_gci511665,00.html.

Firewall. A hardware and/or software system designed to prevent users outside a network from accessing internal network data resources and for controlling what outside resources the internal users may access. A detailed explanation of various firewall types can be found at www.webopedia.com/TERM/f/firewall.html.

GPRS. Acronym for **G**eneral **P**acket **R**adio **S**ervice. A 2.5G technology being implemented in GSM networks. It is a packet-based, "always on" technology with data transfer speeds of up to 115 Kbps. Current GSM systems offer 9.6 Kbps speeds. For more information, see the article at www.networkmagazine.com/article/NMG20001129S0002/3.

GSM. Acronym for **G**lobal **S**ystems for **M**obile **C**ommunications. A 2G digital cellular or PCS standard for how data is coded and transferred through the wireless spectrum. GSM is an alternative to CDMA that is widely used in Europe and other parts of the world. It is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). For a more complete overview, see the GSM World Web site at www.gsmworld.com/index.shtml.

HDML. Acronym for **H**andheld **D**evice **M**arkup **L**anguage. HDML allows for the display of text versions of Web pages on wireless devices. However, HDML was not compliant with HTML (HyperText Markup Language, which is used for Web pages) and has been superseded by Wireless Markup Language (WML). A history of its evolution can be found at www.cjmag.co.jp/magazine/issues/1998/june98/takezaki.html.

IEEE. Acronym for **I**nstitute of **E**lectrical and **E**lectronics **E**ngineers. IEEE develops standards primarily for electronics and related industries. These standards are frequently adopted internationally, such as the IEEE 802 standards for Local Area Networks. Their Web site is www.ieee.org.

IDEN. Acronym for **I**ntegrated **D**igital **E**nhanced **N**etwork. A TDMA-based technology that allows users to access phone calls and two-way radio, paging, and data transmissions on one device. Developed by Motorola, it is used by the Nextel service in North America, as well as by some carriers in South America and parts of Asia. Motorola's iDEN home page is at www.mot.com/LMPS/iDEN/

i-Mode. A protocol used primarily in Japan for transferring packet-based data to handheld devices. It is based on a compact version of HTML and does not use Wireless Access Protocol (WAP) standards. The i-Mode wireless data service offers color and video over many phones. AT&T Wireless and the creator of i-Mode, NTT DoCoMo, may bring the i-Mode service to the U.S. in the future. Specifications can be downloaded form the NTT DoCoMo Web site at www.nttdocomo.com.

IMT-2000. The family of 3G mobile telephony standards (**I**nternational **M**obile **T**elecommunications standards) currently under development by the International Telecommunication Union (ITU). It is also known as W-CDMA, which is short for Wideband CDMA. This is a high-speed 3G mobile wireless technology with the capacity to offer higher data speeds than CDMA. WCDMA can

reach speeds of up to 2 Mbps for voice, video, data, and image transmission. WCDMA was adopted as a standard by the ITU under the name "IMT-2000 direct spread."

The home page for the ITU study group on IMT-2000 is www.itu.int/ITU-T/studygroups/ssg/

Packet, Packet Switched. A way of organizing data for transmission to break larger data streams up into smaller bundles that are pieced back together by the recipient based on header, text, and trailer information in each packet. Packet based networks are typically "always on" and do not require the user to initiate a dial-in to connect to the server.

PCS. Acronym for **P**ersonal **C**ommunication **S**ervices. A general category for two-way digital networks with integrated voice, data, and messaging capabilities.

PDA. Acronym for **P**ersonal **D**igital **A**ssistant. A small computing device based on the Microsoft Pocket PC standard or Palm OS. Generally, "PDA" means the same as "handheld," a term that is more frequently used as the devices have taken on a growing role in corporate computing. PDAs are typically available with embedded E-mail, calendar, address book, task, and memo applications. Third party and custom developed software can extend the functionality of the devices.

PIM. Acronym for **P**ersonal **I**nformation **M**anager. A set of functions for organizing personal information on PCs and PDAs. The functions usually include an address book, calendar, scheduler, notes, and access to E-mail.

Smart phone. A combination of a mobile phone and a PDA. Smart phones differ from normal phones in that they have an open operating system and local storage, so that the user or corporation can add information and applications to the phone as they could with a PDA.

SMS. Acronym for **S**hort **M**essaging **S**ervice. A service through which users can send text-based messages from one device to another. The message is limited to 160 characters. This is typically the delivery mechanism for "E-mail" to digital phones today. The E-mail is converted to an SMS message, truncated to 160 characters, and delivered to the user's handset. More detailed information can be found in the SMS pages at the GSM Web site, www.gsmworld.com/technology/sms/intro.shtml.

TDMA. Acronym for **T**ime **D**ivision **M**ultiple **A**ccess. A wireless technology that allows for increased bandwidth over digital cellular networks. TDMA divides a radio frequency into thee time slots and allocates slots to multiple calls. A single frequency can support multiple, simultaneous data channels.

Upstream. Transmission of data from an end user to a central data source or server.

WAP. Acronym for **W**ireless **A**pplication **P**rotocol. A set of protocols that provide optimized Web access on digital wireless devices such as mobile phones. WAP is designed to work over existing wireless networks including CDMA and GSM, and typically involves a WAP microbrowser on the device and a WAP gateway server at the carrier facility to connect to the Internet. Extensive information and links can be found at the WAP Forum Web site, www.wapforum.org/.

Case studies in WAP applications can be found at the PaloWireless WAP Resource Center, www.palowireless.com/wap/.

Web ring. A Web ring (also *Webring*) is a group of interlinking and related Web sites. Each site has links to the next and previous sites in the ring so that a user can visit each site one after the other. A ring is managed from one main site. The ring manager can add new members to the ring or drop unreachable sites.

The original Web ring system at www.webring.org has links to thousands of special-interest rings and other resources.

WEP. Acronym for **W**ired **E**quivalent **P**rivacy. WEP is a security protocol for wireless local area networks (WLANs) defined in the 802.11b standard. WEP is intended to provide security by encrypting data during transmission. It has been found that WEP is not as secure as its designers had hoped. A response to this finding by the chair of the IEEE committee, and the lively debate that ensued, can be found at slashdot.org/articles/01/02/15/1745204.shtml.

Wireless Spectrum. A band of frequencies where wireless signals travel carrying voice and data information. Wireless spectrum frequencies are typically auctioned or assigned to carriers by each national government.

WLAN. Acronym for **W**ireless **L**ocal **A**rea **N**etwork. Also called Wireless LAN.

WML. Acronym for **W**ireless **M**arkup **L**anguage. A version of HDML, WML is based on XML and will run with its own version of JavaScript. Wireless application developers use WML to re-configure content for wireless devices. WML is the markup standard associated with the WAP protocols. The specifications can be obtained from the WAP Forum Web site www.wapforum.org/what/technical.htm.

XML. Acronym for E**X**tensible **M**arkup **L**anguage. XML is a smaller version of SGML that is designed especially for Web documents and data transmission. Like SGML, it requires designers to create their own Document Type Definitions (DTDs) and customized tags.

Additional References

Wireless and mobile computing is a dynamic industry that is changing quickly. Definitions for the newest, most arcane or more obscure terms may be found only in online sources. The following are just a few of the more prominent or extensive references that can be found on the Internet:

Aether Systems: www.aethersystems.com/wireless/glossary.asp
Alpha Paging Software:
www.alphapagingsoftware.com/wirelessglossary.html
JP Mobile:
www.jpmobile.com/include/Glossary_JP_Mobile_Computing.pdf
Microsoft: www.microsoft.com/business/mobility/moglossary.asp
MobileInfo: www.mobileinfo.com/Glossary/
Wireless Advisor: www.wirelessadvisor.com/Glossary.cfm

Annotated Bibliography on Wireless and Mobile Computing

The list that follows is neither exhaustive nor comprehensive. These reference works were selected because they cover aspects of wireless and/or mobile computing that are important to state agency IRMs.

Government Specific

Wireless Technology in Government. Intergovernmental Advisory Board, Federation of Government Information Processing Councils, in Cooperation with the Office of Intergovernmental Solutions, Office of Government-wide Policy, [and] U.S. General Services Administration. Nov. 2001. Retrieved 5-Feb-2002 from <www.gsa.gov/attachments/GSA_PUBLICATIONS/pub/Final-Wireless-Technology-in-Government-11-14-01.doc>.

This document's Executive Summary is a report on the state of wireless (not necessarily mobile) applications as of 2001. The rest of the document is composed of 16 case studies of wireless applications in government and private sector environments from which the Executive Summary was derived.

M-Government: The Convergence of Wireless Technologies and e-Government, 2001. The National Electronic Commerce Coordinating Council (NECCC), Prepared by the M-Government Team of the 2001 NECCC Research and Development Workgroup.

A white paper for CIOs and government agency executives. It provides a good summary of technologies, issues, and applications from the perspective of e-government.

Non-Government Specific

Enterprise Handheld Apps Emerge. Gillett, Frank E. Mar. 2001. Forrester Research, Inc., Cambridge, MA

The report is written at the executive level to help decision makers guide the deployment of mobile handheld devices and applications. The research is based on interviews with 50 representatives of Global 3500 companies. Hence, it focuses primarily on the private sector.

Forrester finds that the wireless and mobile segment is not mature yet, and recommends that adopters standardize platforms wherever possible and develop their own internal applications to achieve the best ROI.

IT Trends: Managing Mobility: Giga Planning Assumption, Aug. 2001. Smiley, Ken, with Brownlee Thomas and Norbert Kriebel. Giga Information Group, Cambridge, MA.

This article is written for corporate executives to provide guidance on business objectives of wireless and mobile devices and applications. They focus heavily on support and security issues unique to the technology areas.

"Changing the Channel for Mobile Applications," Web & Collaboration Strategies, Fourth 2000 Trend Teleconference Transcript: Jack Gold, Vice President, WCS; David Folger, Senior Program Director, WCS; Craig Roth, Program Director, WCS; Tom Murphy, Program Director, ADS, Sept. 19, 2000. META Group Inc.

This is a transcript of a META teleconference on wireless and mobile technologies and applications. This report is geared toward large private sector corporations. However, most of the detailed management advice applies quite well to government entities.

Beginner's Guide to Implementing a Successful Wireless Solution, Nov. 1999. Nettech Systems. Inc., Princeton, NJ. Retrieved 5-Feb-2002 from <www.wirelessdevnet.com/library/guidewp.pdf>.

This document is a checklist of things to consider when developing wireless applications. While it is not exhaustive, it does include a timeline of events and covers topics that conventional IT development procedures may not include.

The CIO Wireless Resource Book, 2001. Synchrologic, Inc., Alpharetta, GA. Retrieved 5-Feb-2002 from <www.synchrologic.com/images/whitepapers/cio_wireless_main.html>.

While this sounds like an overview, it is really an in-depth discussion of planning wireless and mobile applications (as opposed to just supporting mobile devices). It has an extensive section on how wireless applications fit into existing IT and telecommunication architectures.

Synchrologic provides software to manage synchronization of data between mobile devices and central databases. A few case studies are given to show how wireless applications benefit field support staff and other mobile workers.

The iHealth Reports: Wireless and Mobile Computing, Oct. 2001. Prepared by Fran Turisco and Joana Case, First Consulting Group, for the California HealthCare Foundation.

This report focuses on surveying wireless and mobile computing devices and applications in healthcare. It contains discussions of security, privacy, and HIPAA concerns. There are also extensive appendices referencing other resources for information systems in health and human services.

Wireless LAN Security, 1992-2001. Cisco Systems, San Jose, CA. Retrieved 25-Feb-2002 from <www.cisco.com/warp/public/cc/pd/witc/ao350ap/prodlit/a350w_ov.pdf>.

Although this white paper focuses primarily on Cisco products, it provides a good background on security and technical issues faced by all vendors and their customers. This document has been republished several times at various sites on the Internet.

Wireless Developer, 1995-2002. Sun Microsystems, Inc. Web site: <wireless.java.sun.com/>

The Web site focuses on Sun's programming language, Java, and its application in embedded and other small systems. This is an excellent site for understanding developers' challenges in wireless and mobile applications.

JP Mobile Computing Glossary, May 2001. JP Mobile, Dallas TX. Retrieved 7-Feb-2002 from <www.jpmobile.com/include/Glossary_JP_Mobile_Computing.pdf>

A very thorough glossary that can be downloaded as a document in PDF format.

CompInfo - The Computer Information Center: Mobile Computing, 1995-2002. The Computer Information Center Web site: <www.compinfo-center.com/tpmobl-t.htm>.

Extensive list of URLs and Internet links to all areas of information about wireless and mobile computing.

"Mobile and Wireless Research Links," *Computerworld Knowledge Center*. 2002. Computerworld Inc. Web site: <www.computerworld.com/mobiletopics/mobile/resources/0,11188,KEY68,00.html>

Continually updated and extensive list of links to sources of information about wireless and mobile computing. The list also includes associations, forums, books, and other Internet sites that contain links.

M-Commerce World Whitepaper Library, 1998-2002. Web site: <whitepaperlibrary.m-commerceworld.com/data/rlist?t=pd_10_20_72>.

Links to white papers on wireless and mobile computing.

Endnotes

1 Smiley, Ken, with Thomas Brownlee and Norbert Kriebel. *IT Trends: Managing Mobility: Giga Planning Assumption*.

2 Ibid.

3 Ibid.

4 *Wireless LAN Security*. San Jose, CA: Cisco Systems, 2001.

5 Kriebel, Norbert. *Managing Mobile Systems: Giga Planning Assumption*. May 19, 2000. Cambridge, MA: Giga Information Group.

6 *Wireless Technology in Government*. Intergovernmental Advisory Board, Federation of Government Information Processing Councils, in Cooperation with the Office of Intergovernmental Solutions, Office of Government-wide Policy, [and] U.S. General Services Administration.

7 Ehisen, Richard. "Mobilizing Inspectors: Wireless technology makes Texas field staff more effective." *Government Technology: Mobile Government*. September 2001. Retrieved 25-Feb-2002 from <www.hansen.com/NEWS/InthePress/GovTechSep01/MobileInsp.htm>.